APPENDIX M

SHORT-WAVE ULTRAVIOLET RAYS FOR SEGREGATION OF COMMINGLED REMAINS

M-1. General

The short-wave ultraviolet lamp can be used in certain instances for accurately segregating commingled remains. Equipment used consists of a portable ultraviolet lamp (2537 angstrom units). Bone surfaces exposed to short-wave ultraviolet irradiation generally reflect a variety of colors. The wide range of colors emitted and the fixed relationship of these colors to the substances that emit them justify the attempt to apply these qualities to the segregation of commingled skeletal remains. The color range includes varying shades of red, orange, yellow, green, blue, purple, and brown.

M-2. Sources of Color

The radiated color is derived from two sources which may be generally classified as fluorescence and reflected light.

a. Fluorescence. Fluorescence accounts for most of the color radiation seen in bone. The ultraviolet rays excite certain organic elements which in turn fluoresce. Therefore, the radiated color is directly related to the elements present on the bone surfaces. When a remains is buried, a variety of chemical interactions begin between the bones and their burial environment. These interactions may add a number of inorganic substances to the bone surfaces, all emitting their characteristic color patterns. The importance of surface contamination to color emission should be borne in mind. Scraping of the surface area of a bone which radiated one color under the ultraviolet lamp may emit another color and show no trace of the original color emitted.

b. Reflected Light. Although most ultraviolet rays are absorbed by the bone surface, a certain percentage, which varies depending on the condition of the bone, is reflected back. This reflected light (blue, because of the blue filter used in the ultraviolet source) may be great enough to completely cloak low levels of organic or inorganic fluorescence, or it may blend with that of the fluorescing substances. The visible radiation seen under ultraviolet exposure cannot be identified solely as bone fluorescence but represents a combination of the fluorescence of organic substances, fluorescence of variable quantities of mineral substances introduced to the bone surfaces from external environment, and the reflected blue filter color of the ultraviolet source.

M-3. Exposure of Remains to Ultraviolet Irradiation

a. Skeletal Remains. Mixed skeletal remains exposed to ultraviolet rays emit color differences which differentiate sufficiently to justify segregation. Bones belonging to some individuals are differentiated on the basis of color similarity, although when color differences cannot be detected, segregation may be accomplished by matching similar patterns of color. Shading differences may not be immediately noticeable but are detectable after the bone has been exposed for approximately 30 seconds.

b. Mixed Cadaver Material. Bone segregation in mixed cadaver material may be accomplished by observing the color differences as well as the depth and shade of color. Also, the color is usually spotty and forms complex patterns. Most cadaver bone emits a white, pale yellow, or light green fluorescence, especially from the shafts of the long bones and the flat surfaces of the other skeletal members. Many of these bones emit light blue, non fluorescent spots on the areas of articulation. Paired cadaver humeri generally exhibit equal color intensities as well as color pattern; for example, the pattern of light blue spots are approximately the same for both the right and left bones. There does not appear to be any distinguishable color or pattern differences between the sexes or racial groups.

M-4. Conclusion

When other techniques for segregating commingled skeletal remains have failed, short -wave ultraviolet irradiation may be used as a possible supplement. The procedure is fast, and the investigator sees either distinct and dramatic color differences or undifferentiated uniformity.